THE PARATHYROID GLANDS.

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HISTOLOGY.—In 1880 Sandstrom discovered a pair of small glandular masses lying in close relation to the posterior part of each lateral lobe of the thyroid gland. These he named the parathyroid glands.

These parathyroid glands are small reddish-brown or yellowish-brown ductless organs. Most of the glands are of the reddish-brown color, due to the rich blood supply. When the gland assumes the yellowish tint it is because of the amount of fat that it contains. Of thirty-seven glands observed only one was of the yellowish hue. They are flattened antero-posteriorly and the long diameter is generally in the superio-inferior direction. They are somewhat bean shaped or better still kidney shaped with a sort of a hilum where the artery enters. In size they vary greatly. The average long diameter is one-quarter of an inch while in width we have an average of one-eighth of an inch and the thickness of one-eighth of an inch. They range in size in the long diameter from one-sixteenth to seven-sixteenths of an inch.

Each gland is composed of solid irregular masses of epithelium like cells arranged in columns. These columns of cells anastomose with one another. Numerous blood-vessels are seen between the individual columns, but there are none between the individual cells. The parathyroid is absolutely different from the thyroid and is not like an accessory thyroid. The latter are always of thyroid tissue. Lymph follicles have been found in the parathyroid glands. Each parathyroid has a separate and distinct capsule similar to that of the thyroid but very much thinner. Wherever this gland may be found it is always within its own capsule. The capsule itself may be intimately connected with the thyroid capsule, but the substance of the gland never has any outside connections. This capsule sends off septa that separate and support the cell columns. There are no septa between the individual cells.

Gley thought that the parathyroids represented embryonic portions of the thyroid. Later and after more extended study he proved that they were of their own kind, that is, not like any other gland. Pienant finds them similar in appearance and structure to the carotid bodies. Welsh considers that they resemble the anterior lobe of the pituitary body more than they do the suprarenal glands, as claimed by Richardson, and that they are unlike thyroid tissue. MacCallum and all recent writers are agreed that these organs are separate and distinct glands and have a different function than the thyroid gland.

Number.—Four is the usual number of parathyroids in the human body. There may be as many as five or only one can be found. Because of their small size and the variety of location one may overlook them. Another factor that makes them difficult to find is the yellowish color, which so resembles fat that they are passed over as fat globules. Again the brownish ones so resemble muscle that when dissecting the thyroid free from its surrounding structures a small piece of muscle may be taken for the gland. A lobule of fat that is bruised, that is, slight bleeding has taken place in it, is very similar to the parathyroid. The difference can be told by touch for the gland gives a peculiar hard feel that the fat lobule does not give even when filled with blood.

Although the number four gives an anatomical symmetrical classification this arrangement is found wanting in over 25 per cent. of the cases. Berkeley found but 2.5 glands to the person in 125 autopsies. Pool 2.9 in sixteen thyroids examined. In twelve subjects that I examined I found thirty-seven parathyroids or $3^1/_{12}$ glands to the person. It is claimed that the superior are more constant in number but my findings have been: superior seventeen and inferior twenty. Of course, a greater number may change this proportion. It is also claimed that if there is only one parathyroid found it is the superior. I cannot prove this from my dissections for I never found less than two to a person. I have been unable to find more than four to a subject although the fifth one has been found a number of times. This fifth gland is usually some distance from the thyroid itself.

Location.—The parathyroid glands are generally located on the posterior surface of the capsule of the thyroid gland. They are outside of the capsule and closely adherent to its surface. Thirty-four of the thirty-seven parathyroids found were on or adherent to the posterior surface of the capsule of the thyroid. Inside the capsule of the thyroid I found one, and some have been found on the anterior surface of its isthmus.

The superiors are generally located on a level with the cricoid cartilage. Or on the level of that space between the cricoid and the upper margin of the isthmus of the thyroid. The superiors may be found anywhere from the level of the lower border of the isthmus to the summit of the lobe. Occasionally a parathyroid is found above the thyroid. The thyroid gland wrapping itself about the trachea has its lateral lobes in relation to the trachea and the œsophagus. Now in one-third of the cases the parathyroid will be found in relation to the above mentioned structures at their junction. The superior may be found below the isthmus of the thyroid. This is rare. I found it once. These two superiors are called internal because they are generally located on the posterior-internal surface of the thyroid. They are more constant in position for when they are present they will be found in that limited area of the upper two-thirds of the posterior surface of the thyroid gland.

The two inferior or external bodies are more varied in their location. They are called external for the reason of their being further away from the median line than the superiors. Also from their location on the posterio-external surface of the lateral lobe. The usual location is at or within one-half inch of the lowest part of the lobe of the thyroid gland. It may be found either anterior or posterior to the recurrent laryngeal nerve. When one is found posterior to the nerve it is usually the left. Its relation to the inferior thyroid artery is inferior to the branches that pass to the posterior surface of the thyroid. In only one instance did I find a parathyroid gland above the inferior artery. It is always close to the artery. The parathyroid may be just below the thyroid or some distance from it. Even on or in the substance of the thymus gland they have been found. It is not rare to find one just within the thorax. The lower parathyroids are more difficult to find for the following reasons: First, they are not in so close a relation to the posterior capsule of the thyroid; second, often in the loose fat just below the gland; third, because there is more fat here than around the location of the superiors; fourth, the inferior are somewhat smaller than the superior. Evans found that six out of nineteen inferior parathyroids were below the gland, but considers it unique to have this great proportion. I found but two out of twenty below the gland.

When the four are found it is always a superior and an inferior to each lateral lobe of the thyroid. With three the arrangement may be two superior and one inferior or vice versa. Given but two glands the usual positions are an inferior and a superior. Four had this placing while one had two inferior parathyroids, one being on each lateral lobe. They may be on the same lobe or one on each lobe. I found them three times on the same lobe while in two other specimens the arrangement was one on each lobe. This was the placing in the five times that I found but two parathyroids to the person. I can find no statistics bearing on this point.

The Blood-Supply.—The parathyroid glands are always supplied by a special parathyroid artery. This artery supplies the gland itself and nothing else. It is always a direct and separate branch of the thyroid arteries or one of their main divisions. At times two or more arteries are seen running to the gland but only one enters the gland. The others supply the fat around the gland. This parathyroid artery enters a hilus in the gland. When the parathyroid is adherent to or within the capsule of the thyroid, the capsules have an arterial anastomosis. This anastomosis ends with the capsules, there never being any communication with the gland itself.

In about 50 per cent. of the cases there is a large anastomosis on the posterior surface of the capsule of the thyroid, formed by the two arteries on the same side. This has been termed the channel. This arterial anastomotic channel is formed by the superior and inferior thyroid arteries of that side of the neck only. It runs along the posterior surface of a lateral lobe and generally near the mesial border. Its formation is usually as follows: The superior thyroid artery divides into two main divisions when it reaches the thyroid gland. One we will call internal, *i.e.*, nearer the medial lobe, the other external. The inferior thyroid artery on reaching the gland divides into two or three main branches. We will call these internal, middle and external as per the arrangement given for the superior. Either the internal or the external of the superior anastomoses with internal or middle of the inferior artery to form the channel. It is very uncommon to find the external division of the inferior forming the channel. The usual arrangement is for the two internals to form this channel, which I found in thirteen of the twenty-four specimens examined.

The inferior parathyroid artery is always a branch of the inferior thyroid artery or of the channel of anastomosis. The *superior parathyroid artery may be a branch of the superior* thyroid artery. Pool states that it is always supplied by the superior thyroid artery. This statement does not follow my observations. The supply was always from a direct branch of the inferior thyroid artery or from the channel. Even when from the channel, the angle of direction of the artery, is such, as to lead one to the conclusion that the blood comes from the inferior artery. In the seventeen superior parathyroid glands found none got their artery from the superior thyroid. Therefore, it would seem, from this, that it is extremely rare for these upper glands to be supplied from the superior thyroid artery. When the parathyroid artery does not come from the channel it most often comes from either one of the two internal branches of the inferior artery.

In three specimens the parathyroid artery was found a direct branch of the inferior thyroid artery. As seen in Fig. 1 the parathyroid artery arose from near the thyroid axis. This was three inches long. It is very frequent that the superior and inferior glands are supplied by the same division of the inferior thyroid artery. It is of great importance to note, that at times the two internal divisions of the inferior thyroid artery anastomose across the isthmus of the thyroid gland. This is of prime surgical importance as will be shown below. Twice the œsophageal artery of the inferior thyroid gave off the inferior parathyroid artery. This is another important point in the operations and their results. The parathyroid artery may also be a branch of one of the main muscular thyroid arteries.

Results of Injury to the Parathyroid Glands.—Although we have no exact knowledge of the functions of these glands we must now recognize them, preserve them and keep their blood-supply inviolate. That there is a function we have no further reason to doubt.

It has been shown by Gley, Vassalé and Generali that when the parathyroid glands are removed in dogs death results in about three days of a generalized tetany. Destruction of the thyroid alone produces disturbances of metabolism, which appear slowly, and gradually lead to myxedema. Destruction of the parathyroids alone produces acute, rapid, fatal nervous phemonena, that is, tetany. This tetany is of central nervous origin. The tetany can be relieved for a short time by bleeding and transfusion of saline into the veins. This would lead one to believe that there was a toxin in the blood. Feeding of the parathyroid gland does not stop death. All recent writers agree that tetany and death must result from the removal of all the parathyroids. The destruction of their blood-supply causes the same fatal result.

In the great majority of cases the tetany following operation for the removal of all or part of the thyroid gland, is not due to the removal of the parathyroids themselves. It is due to the destruction of their blood-supply. This is a well proved fact. In the numerous thyroids examined after operative removal few parathyroids have been found. Therefore the tetany following must have been caused by the cutting off of the blood-supply of the remaining gland or glands. Halsted states that tetany results even from the ligation of but one thyroid artery. This fact is proved in one of my specimens, as per Fig. 5, if the inferior thyroid were tied the only two glands would loose their blood-supply and therefore be destroyed. This would also result in the case as shown in Fig. 7. Kocher directs that two arteries should never be tied at one sitting and that never more than one-half of the thyroid gland should be removed except for some special reason. The same specimens give great weight to his dictum.

The Surgical Saving of the Parathyroid Glands.—I believe that, with a proper operation and careful dissection, the whole thyroid gland can be removed without causing tetany. The essential thing in the operation is to recognize the parathyroid glands and their blood-vessels. Neither of these must be injured.

The operation is as follows: Make the collar incision and reflect upward the skin for one-half inch and then make a similar incision in the platysma muscle superior to that of the skin. All vessels that bleed ever so little must be at once clamped. This rule must be followed throughout the operation as staining of the field with blood is fatal to a good dissection. It also increases the difficulty in locating the parathyroids. Reflect this skin-muscle flap well above the summit of the thyroid. Now make a mid-line vertical incision through the fascia only deep enough to enable one to raise the sterno-hyoid and omo-hyoid muscles. Raise these muscles and put two clamps on them as near the hyoid bone as possible, cut between the clamps and do not remove same till ready to suture muscles (Mayo). Clamp and cut the sterno-thyroid muscle separately thereby saving bleeding and giving more room by being able to retract the two former muscles more freely (Halsted). The sterno-thyroid muscle is a very vascular muscle and being well spread out over the thyroid gland is difficult to separate and retract without free bleeding therefore Halsted's plan is excellent. All severed muscles now being strongly retracted you raise the lobe from its bed. Be careful not to tear the delicate blood-vessels entering it. Now grasp the upper pole with the fingers and make traction forward and in towards the median line. This brings the superior thyroid vessels that enter the gland into view. Working now from the external superior border of the gland and towards the median line clamp all vessels as they enter the gland. Clamp these vessels as close to the gland as possible. It is not necessary to clamp on the gland side as the traction put on the lobe stops oozing. Cut between the clamp and the gland. By this method of clamping and cutting the freeing of the upper pole is easy and there is slight danger of injury to the superior parathyroid. With the upper pole free draw a little more downward and inward so to put the inferior thyroid artery branches on the stretch. Clamp these as they enter the gland. Be careful of too much pressure on the trachea. Intermittent traction from now on is better. This shortly brings into view the two or three main branches of the artery. As this vessel is tortuous, the traction made straightens the artery and the lobe can be turned so as to expose its posterior surface. The parathyroid should be found and its artery traced to its source. Clamp the thyroid branch distal to this source. The other one or two divisions may now be clamped with impunity. This frees the whole lobe and the recurrent laryngeal nerve is seen and thus avoided. Halsted after bringing into view the inferior thyroid vessels notes where they enter the gland. He plunges a sharp pointed clamp into the substance of the gland at this point seizing the vessels. Cutting distal to this frees the gland and saves the blood-supply of the parathyroids. Either method is safe.

There can be shown a number of important surgical points from the specimens that I have. Fig. 1, the older operation of complete removal of the thyroid could have been successfully done. The left inferior parathyroid not injured on account of its artery arising from the main trunk of the

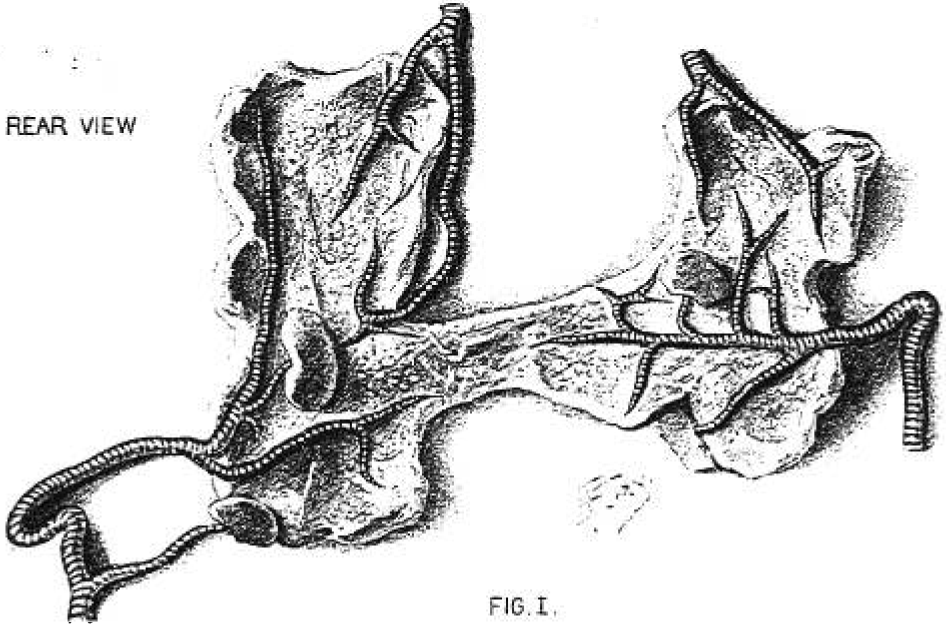

FIG. I.

The parathyroid glandules and their vascular supply.

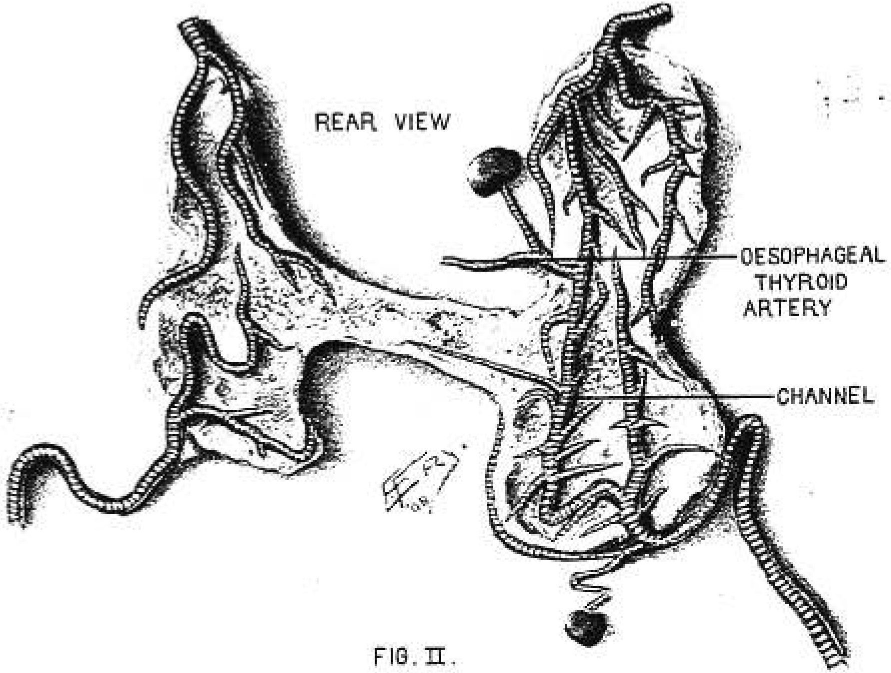

FIG. II.

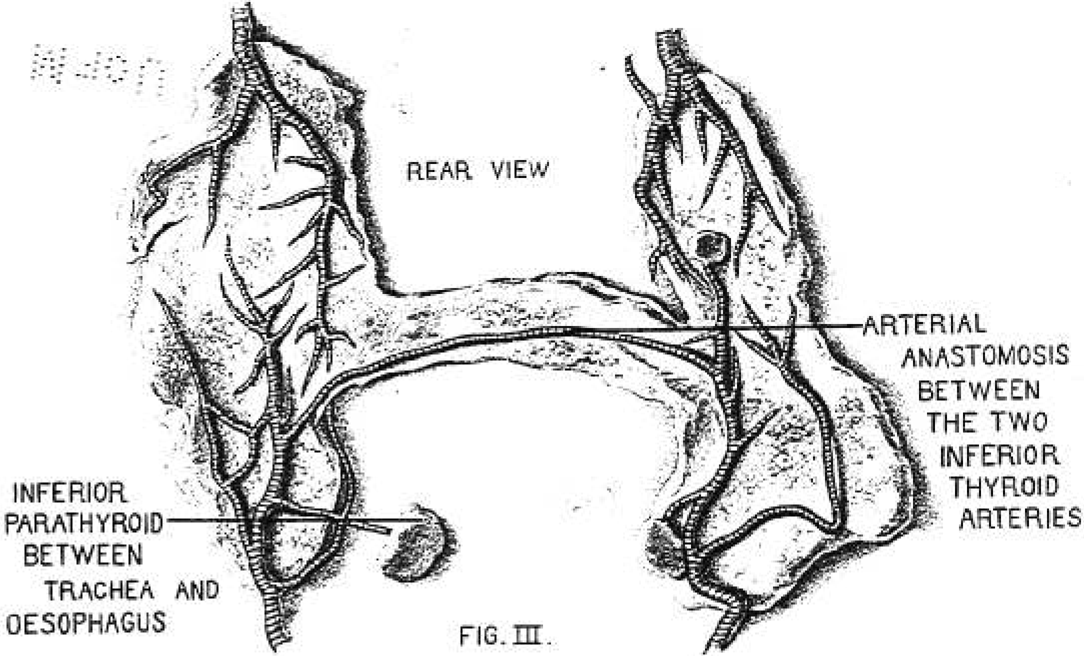
REAR VIEW
INFERIOR PARATHYROID BETWEEN TRACHEA AND OESOPHAGUS
ARTERIAL ANASTOMOSIS BETWEEN THE TWO INFERIOR THYROID ARTERIES

FIG. III.

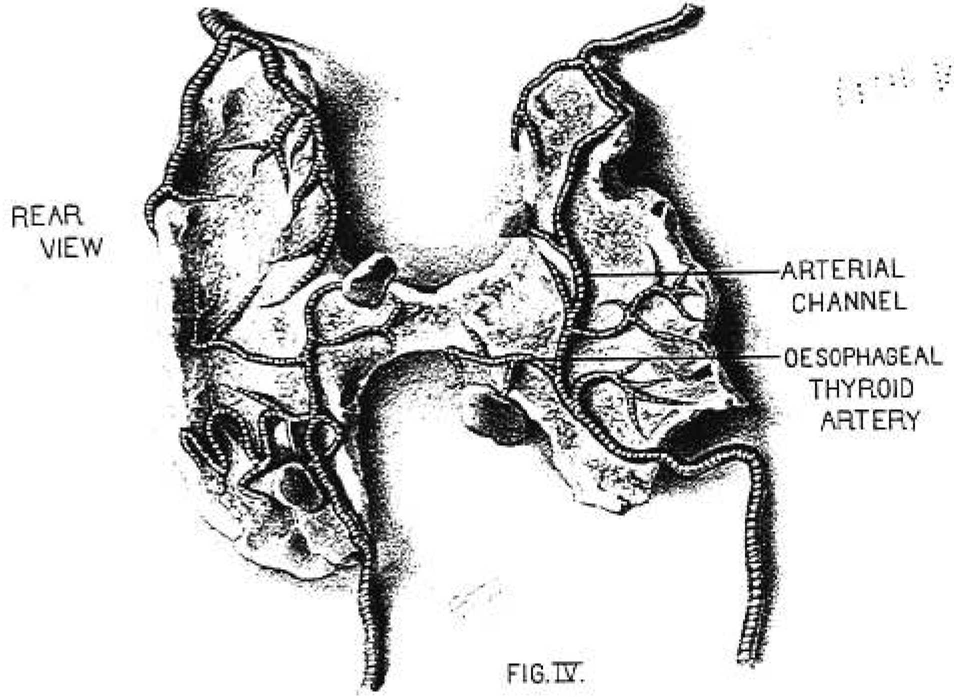

FIG. IV.

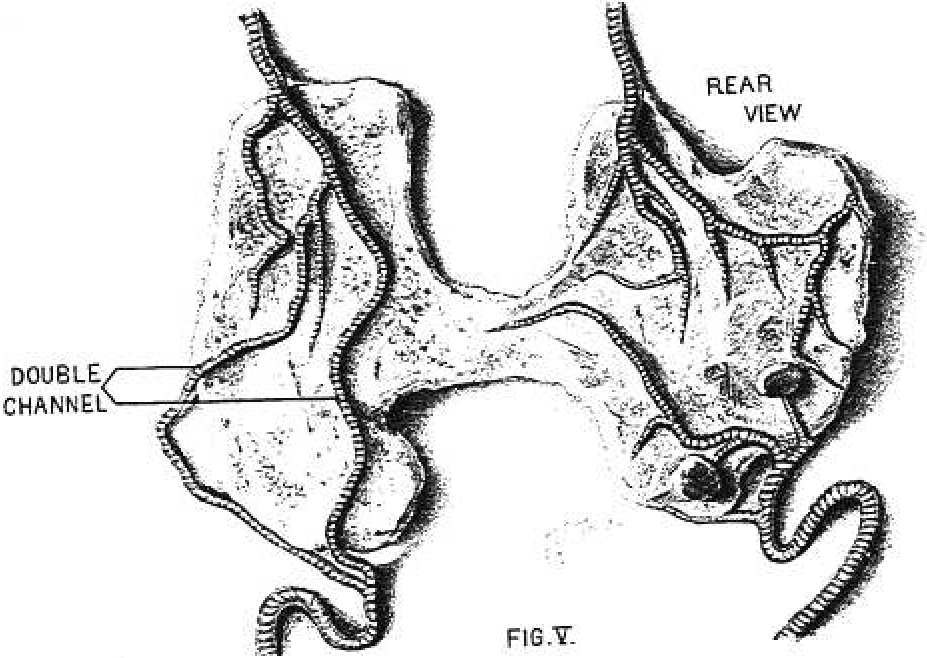

FIG. V.

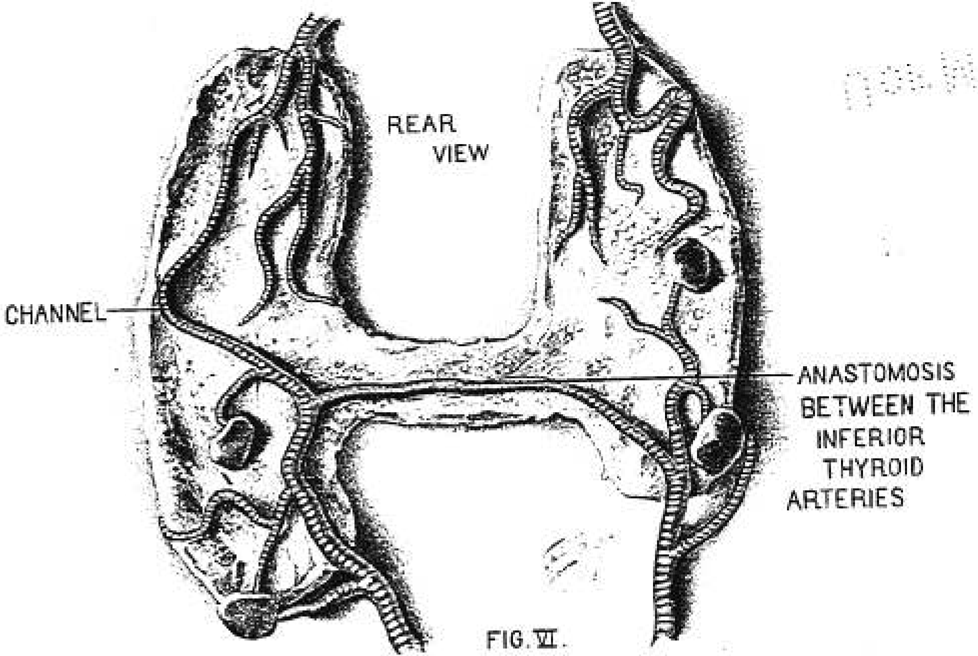
REAR
VIEW
CHANNEL
ANASTOMOSIS
BETWEEN THE
INFERIOR
THYROID
ARTERIES

FIG. VI.

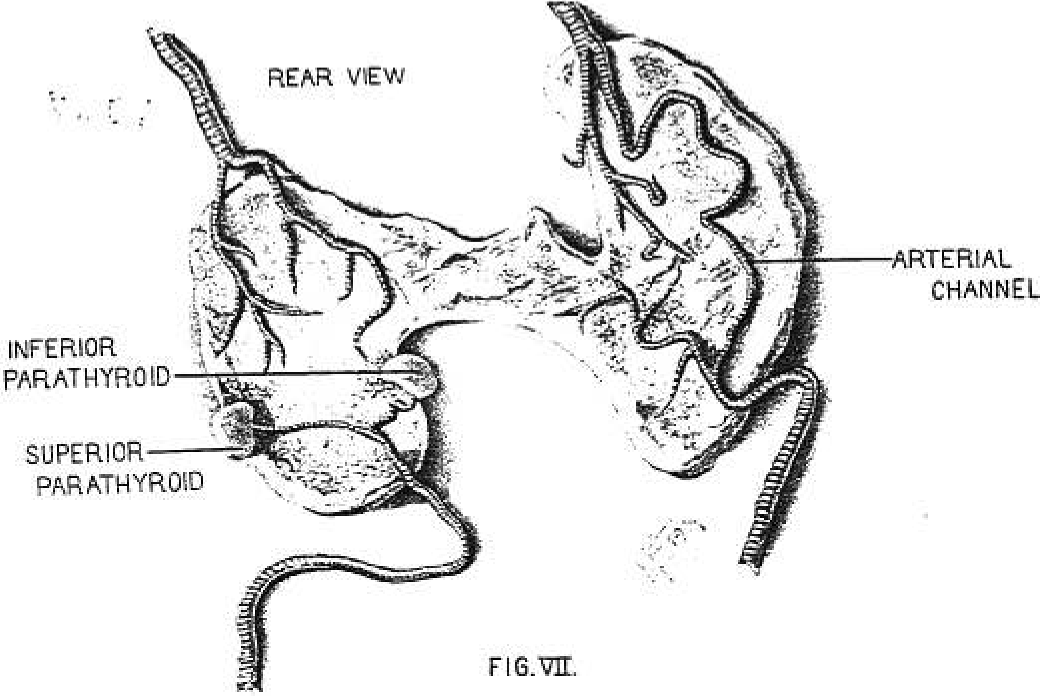
REAR VIEW
ARTERIAL CHANNEL
INFERIOR PARATHYROID
SUPERIOR PARATHYROID

FIG. VII.

thyroid artery. Figs. 2 and 4 offer another explanation why tetany did not result with removal of the whole thyroid. In Fig. 2 the superior gland was not connected with the capsule. It would therefore be left. Its blood-supply would be maintained by the œsophageal connection with the parathyroid artery. Fig. 4 shows the right inferior parathyroid artery a branch of the œsophageal thyroid artery and this gland was only touching the capsule of the thyroid. As all œsophageal arteries anastomose with one another the supply of blood is assured. In Figs. 3 and 6 because of the two inferior thyroid arteries forming an anastomosis with one another across the isthmus of the thyroid, one would be safe in removal of one-half of the gland or the ligation of two arteries on one side. In either case the saving of one gland and its blood is sure.

SUMMARY.

1. The parathyroid glands are essential organs.
2. Each gland has a separate and distinct capsule.
3. The average number to a person is about three.
4. They are generally located on the posterior surface of the capsule of the thyroid.
5. Each parathyroid gland has a special parathyroid artery that supplies it and it alone.
6. Destruction of the parathyroids causes death from tetany.
7. Cutting off of the blood-supply causes the same fatal result.
8. The loss of their blood-supply is the more frequent cause of death.
9. To save them and maintain their blood-supply only the arteries that enter the thyroid gland should be cut.
10. The safest method of operating is from above downward.